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TITLE: METHOD OF HANDLING CONTEXT DURING
SCALING WITH A DISPLAY

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1 METHOD OF HANDLING CONTEXT
2 DURING SCALING WITH A MAP DISPLAY

3 BACKGROUND OF THE INVENTION

4 The present invention relates to the presentation of map information on a display
5 screen of a computing device, and more particularly, the present invention relates to a
6 way to improve the presentation of map information on a display screen of a computing
7 device when a user zooms in or out.

8 There are various computing platforms that graphically display maps of
9 geographic areas. For example, some in-vehicle navigation systems include a display
10 screen upon which a map of a geographic area can be displayed graphically. In addition,
11 by using appropriate software applications, maps can also be displayed on general
12 purpose computing platforms, such as personal computers and personal digital assistants.

13 Some computing platforms and applications that display maps graphically include
14 features that allow a user to interact with the map. Various types of user interaction may
15 be supported. Among the features that may be supported is the ability to zoom in or out.
16 When a user zooms in on a map, a sub-portion of the originally displayed map is selected.
17 The user may operate a pointing device for this purpose. Then, a new map is graphically
18 displayed. The new map corresponds to the geographic area of the selected sub-portion
19 of the originally displayed map. The new map is at a larger scale than the originally
20 displayed map so that new map fills the same area on the display screen of the computing
21 device on which the originally displayed map had been shown.

22 When a user zooms out on a graphically displayed map, the new map is at a
23 smaller scale than the previously displayed map. The new map corresponds to a
24 geographic area that is larger than the geographic area that corresponds to the previously
25 displayed map such that the geographic area that corresponds to the previously displayed
26 map is only a sub-portion of the geographic area that corresponds to the new map.

27 Maps shown at different scales on display screens may include different levels of
28 detail. This is done in order to make it easier for a user to read and understand the

1 information presented on the map. For example, large-scale maps may include more
2 detail (e.g., all the streets and other cartographic features may be displayed) whereas
3 small-scale maps may include less detail (e.g., secondary streets and minor features may
4 be omitted). If secondary streets and minor features were not omitted on a small-scale
5 map, the display would contain so much information that a user may find it difficult to
6 understand.

7 Because maps at different scales are associated with different levels of detail, a
8 lower level layer of map information may become visible or disappear when a user is
9 zooming in and out on a map. The sudden appearance or disappearance of an entire level
10 of map information may sometimes be confusing to the user. In addition, geographic
11 features may be represented differently at different levels of detail. For example, on a
12 large scale map (i.e., a map with a high level of detail), a road on which the lanes are
13 separated by a median may be represented by two separate lines—one line representing
14 the lanes on one side of the median and the other line representing the lanes on the other
15 side of the median. However, on a small scale map (i.e., a map with a low level of
16 detail), a road on which the lanes are separated by median may be represented by only a
17 single line. This change in the appearance of represented features that occurs when
18 zooming in and out on a map can also be confusing to a user. For example, if an area or
19 intersection changes shape significantly when the scale is changed, the user may lose
20 his/her point of reference on the map, i.e., he/she may become unsure where on the map it
21 was that he/she was viewing. This can lead to repeated zooms in and then out while the
22 user tries to determine which roads and features remain the same across the transition
23 between levels of detail.

24 Accordingly, there is a need for an improved way to represent map features when
25 zooming in and out.

26

27 SUMMARY OF THE INVENTION

28 To address these and other objectives, the present invention comprises a method
29 for representing geographic features when a map display is zoomed in or out. The
30 method includes displaying a starting image that shows geographic features at a first
31 scale with a first level of detail and then displaying an ending image that shows the same

1 geographic features at a second scale with a second level of detail. Between the
2 displaying of the starting image and the displaying of the ending image, at least one
3 intermediate image is displayed. The intermediate image combines two component
4 images of at least some of the same geographic features shown in the starting or ending
5 image. The two component images in the intermediate image are at the same scale and
6 are registered with respect to each other so that the same geographic features represented
7 in the two component images coincide. One of the two component images in the
8 intermediate image includes at least a portion of the starting image and is formed using
9 data from a first layer of a geographic database. The other of the two component images
10 in the intermediate image is formed using data from a second layer of the geographic
11 database.

12 13 BRIEF DESCRIPTION OF THE DRAWINGS

14 Figure 1 is a diagram illustrating a computing platform that incorporates an
15 embodiment of a feature for a map display that provides context during scaling.

16 Figure 2 is a diagram of the database in Figure 1 and shows an arrangement for
17 organizing the database into layers.

18 Figure 3 is an illustration of the display screen of Figure 1 with a first map image
19 of a geographic feature displayed thereon.

20 Figure 4 is an illustration of the display screen of Figure 1 with an intermediate
21 map image of the same geographic feature as shown in Figure 3 displayed thereon.

22 Figure 5 is another illustration of the display screen of Figure 1 with another
23 intermediate map image of the same geographic feature as shown in Figures 3 and 4
24 displayed thereon.

25 Figure 6 is another illustration of the display screen of Figure 1 with yet another
26 intermediate map image of the same geographic feature as shown in Figures 3-5
27 displayed thereon.

28 Figure 7 is another illustration of the display screen of Figure 1 with still another
29 intermediate map image of the same geographic feature as shown in Figures 3-6
30 displayed thereon.

1 Figure 8 is an illustration of the display screen of Figure 1 with a final map image
2 of the same geographic feature as shown in Figures 3-7 displayed thereon after zooming
3 out to a desired scale.

4 Figure 9 is a block diagram showing components in an embodiment whereby data
5 for providing context while scaling are downloaded from a server to a client platform.

6

7 DETAILED DESCRIPTION OF THE
8 PRESENTLY PREFERRED EMBODIMENTS

9 I. Overview of computing platform and geographic database

10 Figure 1 shows a computing platform 10. The computing platform 10 may be an
11 in-vehicle navigation system, a personal navigation system, a personal computer, a
12 personal digital assistant, or other device. The computing platform 10 may be part of a
13 network or may be a standalone device.

14 Associated with the computing platform is a geographic database 14. The
15 geographic database 14 may be located locally with the computing platform 10 or may be
16 located remotely from the computing platform 10. If the geographic database 14 is
17 located remotely from the computing platform 10, the data in the geographic database 14
18 may be provided to the computing platform 10 via a network or other type of
19 communications system. The network or other type of communications system may be
20 wireless, land-based, or a combination of both wireless and land-based. The network
21 may include the Internet.

22 The geographic database 14 includes data from which maps can be graphically
23 rendered. Formats for organizing and accessing a geographic database that includes data
24 from which maps can be graphically rendered are disclosed in U.S. Pat. Nos. 5,968,109
25 and 6,047,280, the disclosures of which are incorporated herein by reference.

26 Associated with the computing platform 10 is a program 18 that uses data from
27 the geographic database 14 to render maps graphically on a display screen 12 of the
28 computing platform 10. There are various ways to implement a program that uses data
29 from a geographic database to render maps graphically. For example, ways to display
30 maps using data from a geographic database are disclosed in U.S. Pat. Nos. 6,092,076
31 and 6,163,749, the disclosures of which are incorporated herein by reference.

1 As mentioned above, when displaying maps at different scales, it may be
2 preferred to provide the maps with different levels of detail. In order to facilitate the
3 presentation of maps at different levels of detail, data that represent geographic features
4 may be organized into layers. Figure 2 is a diagram illustrating an organization of the
5 geographic database 14 into layers. In the embodiment of Figure 2, the geographic
6 database is organized into layers based on a rank associated with the represented features.
7 The lowest rank (e.g., 0) is associated with those features that are represented only when
8 the finest level of detail is desired. In the case of roads, the lowest rank may be
9 associated with side streets and alleys. On the other hand, the highest rank (e.g., 4) is
10 associated with the most important features, i.e., those that would be displayed even at
11 the coarsest level of detail. In the case of roads, the highest rank may be associated with
12 expressways and major arterial roads.

13 When data representing geographic features are organized into layers, the lowest
14 layer (e.g., 0) includes data representing geographic features of all ranks (e.g., 0-4). A
15 highest layer (e.g., 4) includes data representing geographic features of only the highest
16 rank (e.g., 4). Each other layer includes only those data that represent those geographic
17 features of the associated rank and higher ranks. For example, layer 2 includes data that
18 represent geographic features having ranks 2, 3 and 4. Layer 2 excludes data that
19 represents geographic features of ranks 0 and 1.

20 As shown in Figure 2, these layers can exist as separate collections of the
21 geographic data. When a navigation function, such as map display, requires geographic
22 data with a high level of detail, a lower layer is accessed and used. On the other hand,
23 when a navigation function requires geographic data with a low level of detail, a higher
24 layer is accessed and used.

25 In an alternative embodiment, layers can be implemented logically with a single
26 collection of the geographic data. The single collection would include all the data of all
27 the ranks, i.e., similar to layer 0 in Figure 2. When a navigation function requires
28 geographic data with a low level of detail, geographic features having higher ranks are
29 suppressed logically. The logical suppression of higher ranked data is performed using a
30 software program.

31

1 II. Context during scaling feature

2 In accordance with a first embodiment, the map display program (e.g., 18 in
3 Figure 1) implements a feature whereby a user is presented with context information
4 when changing scale, e.g., zooming, with a map being displayed. This context
5 information takes the form of one or more intermediate (or transitional) displays of map
6 information between the original map display (i.e., the map being shown before the user
7 initiates a zooming operation) and the final map display (i.e., the map being shown when
8 the zooming operation is completed). Each intermediate display of map information
9 includes at least portions of two separate layers of map information. The data from these
10 two separate layers of map information are on the screen at the same scale at the same
11 time and overlaid so that the represented features coincide. In at least one of the
12 intermediate displays, the two layers of map information include the layer used for the
13 original map display. The other layer may be the layer used for the final map display, or
14 if there are one or more layers of map information with levels of detail between the level
15 used for the original map display and the level used for the final map display, the other
16 layer included in the intermediate display with the layer used for the original map display
17 may be one of these intermediate layers. By showing an intermediate image that includes
18 both the original map data and data from another layer (either the layer used for the final
19 map display or another layer between the layer used for the original display and the final
20 display), the user is better able to observe the relationship between the original map
21 display and the final map display.

22 In one embodiment, at least one intermediate image is provided for each transition
23 between adjacent layers when zooming. For example, if a user zooms from a map
24 display formed using data from layer 0 to a map display formed using data from layer 4,
25 there are four intermediate images. A first intermediate image shows at least portions of
26 layer 0 and layer 1 at the same time, a second intermediate image shows portions of layer
27 1 and layer 2 at the same time, a third intermediate image shows portions of layer 2 and
28 layer 3 at the same time, and a fourth intermediate image shows portions of layer 3 and
29 layer 4 at the same time. In an alternative embodiment, some of these intermediate
30 images may be omitted or combined. For example, an intermediate image may be
31 formed using data from three separate layers at the same time.

Each intermediate image of map information includes component images formed from portions of at least two separate layers of map information. The component images are on the screen at the same scale at the same time and overlaid so that the represented features coincide. In at least one of the intermediate images, the two layers of map information include the layer used for the original map display.

In order to improve presentation of the map information in an intermediate image when data from two separate layers are on the screen at the same time, the data from one of the layers may be presented at a reduced level of color saturation (e.g., a percentage grayscale) or with a level of transparency. For example, if an intermediate image includes data from layer 0 which had been used for the original map display and data from layer 1, the data from layer 1 may be shown at 50% color saturation (e.g., 50% grayscale). If several intermediate images are presented for this transition (i.e., layer 0 to layer 1), each successive intermediate image would show the layer 0 data with lower levels of color saturation (e.g., 100% to 60% to 20%) while the color saturation of the layer 1 data would increase in each successive intermediate image (e.g., 20% to 40% to 60%).

According to another alternative, the intermediate displays may include both decreasing levels of color saturation (or increasing transparency) for the data obtained from one layer and increasing levels of color saturation (or decreasing transparency) for data obtained from the successive layer. Using any of these alternatives, a gradual fading effect can be implemented. According to another alternative, the intermediate images can be more gradual to increase the fading effect.

Example

An example of an implementation of an embodiment of the map display feature that provides context during scaling is shown in Figures 3-8. Figure 3 shows an illustration of a geographic feature on the display screen 12 of a computing platform (10 in Figure 1). The geographic feature is a complex highway interchange. The illustration in Figure 3 is rendered using data from the geographic database (14 in Figures 1 and 2). The data used to form the map display of Figure 3 is obtained from layer 0 of the geographic database (14 in Figures 1 and 2). In the illustration in Figure 3, there are

1 some rank 0 roads and ramps, a rank 1 road crossing east-west, and a rank 3 double
2 digitized highway. In Figure 3, the data representing this complex interchange is shown
3 at a scale that is zoomed in far enough to see everything. All the roads are present and
4 fully visible.

5 When the image of Figure 3 is being displayed on the display screen 12, the user
6 implements a zooming operation, e.g., zooms out. The user may initiate the zooming
7 operation by manipulating the user interface of the computing platform (10 in Figure 1).
8 For example, the user may use a pointing device, such as a mouse, to select an area on the
9 display and indicate that zooming out is desired. When the user initiates the zooming
10 operation, the program 18 obtains data from the geographic database 14 that corresponds
11 to the same geographic area, but at a smaller scale.

12 Figures 4-7 represent successive intermediate map images and Figure 8 represents
13 the final map display, i.e., the map image at the scale desired by the user when zooming
14 out is fully completed. In Figure 4, a first intermediate image shows layer 0 and layer 1
15 data. The layer 0 data and the layer 1 data are on the screen at the same time. The layer
16 0 data and the layer 1 data are adjusted to the same scale and registered with respect to
17 each other so that the same features represented by each layer coincide (or overlap). The
18 layer 0 data is shown at a 50% color saturation (50% grayscale) and the layer 1 data is
19 shown at full color saturation (100% black).

20 Figure 5 shows a second intermediate image of the same geographic feature (i.e.,
21 the intersection). The image in Figure 5 is displayed after the image of Figure 4. The
22 image of Figure 5 is zoomed out even farther from the image in Figure 4. Layer 0 data is
23 now present only at 20% grayscale.

24 Figure 6 shows a third intermediate image of the intersection. The image in
25 Figure 6 is displayed after the image of Figure 5. The image of Figure 6 shows the
26 intersection zoomed out to where layer 2 is the presentation layer at this scale. The only
27 layer 2 information corresponding to this feature is the two lines of the double digitized
28 highway. According to this embodiment, the layer 1 road running east-west is shown in
29 50% grayscale. This helps the map user retain an idea of where on the highway a point
30 is. The user can relate a location to before or after the overpass. At this scale, the
31 generalized layer 3 version of the highway in gray is beginning to appear. This prepares

1 the map user for the scale at which the two lines representing the highway will turn into a
2 single line.

3 Figure 7 shows another intermediate image. In the intermediate image shown in
4 Figure 7, data from layer 3 shows the highway as a single line. This data from layer 3 is
5 shown at 100% color saturation. The intermediate image shown in Figure 7 also includes
6 data from layer 2 that shows the highway as a pair of double lines. The data from layer 2
7 is shown at 50% color saturation and appears in the intermediate image of Figure 7 as
8 thin gray borders.

9 Figure 8 shows the final map display with the image of the geographic feature
10 fully zoomed out to the scale desired by the user. In Figure 7, the highway is shown as a
11 single thin line with 100% color saturation using only data from layer 3.

12

13 III. ALTERNATIVES

14 A. Scalable Vector Graphics (SVG)

15 Scalable Vector Graphics (SVG) is a proposed standard for web graphics that is
16 being developed by the W3 consortium. SVG envisions a graphics file format with
17 multiple layers of graphics that are developed from polygons, similar to Macromedia
18 Flash or Postscript graphics. Animation is possible with JavaScript code that is part of
19 the graphics file. Transparency of graphics elements are also part of the SVG model.
20 Support for SVG may be included in future browsers, much like support for JPEG and
21 GIF is today.

22 One of the applications for the SVG format is the display of maps. SVG provides
23 the ability to download maps (as vectors) that can be zoomed and possibly panned
24 without further interaction with the server, at least until more data is needed. Although
25 the SVG format may be helpful for displaying some maps, the SVG format has some
26 limitations. An SVG map with full layer 0 detail for a geographic area, along with
27 context higher level information, would look very cluttered in the detail area when
28 zoomed out. Such a map may also be slow to display. In addition, the display may
29 include detail that is too small to see. These difficulties can be addressed using an
30 embodiment of the disclosed map display feature that provides context during scaling.

1 According to one embodiment, a user operates a client-computing platform to
2 request data from a server for a map of a location. The user may access the server over a
3 network, such as the Internet. The user requests the data in a vector format (such as
4 SVG). The server sends the user a file that contains multiple layers of data. The file
5 would be about four times the size of an SVG map that only showed the data for a single
6 layer at one scale. On the client computing platform, the user uses a viewer capable of
7 viewing smooth scale changes, such as a SVG viewer, to view the downloaded data as a
8 map image. Included with the downloaded file would be a routine or script that could be
9 used in the SVG viewer to adjust layer transparency depending upon zoom layer. The
10 routine or script may be written in JavaScript code, for example. Figure 9 illustrates
11 components used to implement this embodiment.

12 According to another embodiment, a user operates a client computing platform to
13 request data from a server for a map of a route. The server sends the user a file that
14 contains multiple layers of data for forming a map for the route. The map for a route
15 includes a nesting set of strip maps centered around the route. Each layer included in the
16 downloaded file would show an area around the route appropriate to the display scale of
17 the layer. As described above, the user uses a viewer, such as an SVG viewer, to view
18 the downloaded data as a map image. The user could zoom in and out of the route, pan
19 along the route and save the downloaded file to transfer to another computer.

20 Using these embodiments, a user can download a map file that will look attractive
21 at any scale. By using the context during scaling feature, the user may find the map data
22 easier to use and understand when performing a zooming operation.

23

24 B. Smooth zooming versus discrete stages zooming

25 As stated above, when a user operates the map display for a zooming operation,
26 the scale of the map changes. The map scale may change in discrete stages or
27 alternatively, the map scale may change gradually, i.e., in stages so small that it appears
28 to the user to be smooth. Embodiments of the context during scaling feature can be used
29 with zooming that occurs in discrete stages or smoothly.

30

1 C. Alternative file formats

2 It was mentioned above how embodiments of the map display feature that
3 provides context during scaling can be used with vector formats, such as SVG.
4 Embodiments of the map display feature that provides context during scaling can also
5 be used with other file formats, including static formats like JPEG or GIF. If a map is
6 provided in a file format, such as a GIF file format or a JPEG file format, the map can be
7 displayed with an appropriate viewer for such a format. A routine included with the
8 downloaded data would provide for displaying the images over one another with the
9 appropriate transparency.

10

11 D. Alternative colors

12 In some of the embodiments described above, when data from two different layers
13 are shown at the same time on the display screen, the data from one of the layers is
14 shown at a reduced level of color saturation. In some of the embodiments, this reduced
15 level of color saturation is a shade of gray. However, the display of geographic features
16 is not limited to black or gray. In alternative embodiments, the geographic features can
17 be shown in any color, such as blue, red, etc. Geographic features shown in these colors
18 can be shown with reduced levels of color saturation (or transparency), as appropriate,
19 when shown in intermediate images with any of the above described embodiments.

20

21 IV. ADVANTAGES

22 The disclosed embodiments provide several advantages. According to the
23 disclosed embodiments, different layers of data can be scaled to appropriate levels of
24 accuracy on the server. When these data are downloaded to a client platform, the data are
25 displayed only within appropriate ranges of scales. In this way, the data are not displayed
26 with unintelligible detail or large overly heavy lines. Each layer can have its own scaling
27 equation.

28

1 It is intended that the foregoing detailed description be regarded as illustrative
2 rather than limiting and that it is understood that the following claims including all
3 equivalents are intended to define the scope of the invention.